

**MISSOURI RIVER EROSION UPDATE
1941-1998**

**YANKTON SIOUX RESERVATION
MARTY, SOUTH DAKOTA**

Prepared For

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EXECUTIVE SUMMARY

Pacific GeoScience has completed a revised study of the erosion of Tribal lands (tracts) located along the Missouri River within the Yankton Sioux Reservation. This riverbank erosion is related to the construction and operation of Fort Randall Dam. This study evaluated the erosion and accretion of Tribal tracts from 1941 through 1998 (the study period), and estimates the value of the net land eroded as a result of dam construction and operation. This report supersedes the ENVIRON report of 1992 and presents a more comprehensive evaluation of the monetary value of the lost acreage. This study utilizes the current tract identification numbers that are consistent with the Bureau of Indian Affairs' (BIA) database. The background and principal findings of this study are as follows:

- The Army Corp of Engineer's (COE) report entitled, *Missouri River Review Report for Water Resources Development* completed in the late-1970s, shows that during the 1946-1952 construction period of the Fort Randall Dam, 945 acres were lost on the 36.3 mile reach of the Missouri River between Fort Randall Dam and Niobrara, Nebraska. During the following period, 1953-1975, an additional 1,058 acres were lost to erosion. This reach of river includes most of the western boundary of the Yankton Sioux Reservation.
- In October 1981, the COE, at the request of the Tribe, provided a Section 55, Streambank Erosion Protection Technical Assistance Report. The COE report stated that during the 1953-1976 period the entire reach, which contains the study areas of our report, has "... experienced severe erosion; and it is not likely to cease in the foreseeable future."
- The severe erosion that has occurred along 17 Tribal tracts of land, that is related to the construction and operation of Fort Randall Dam, has resulted in a loss of 450.3 acres, of which 427.1 acres is prime arable land.
- There are 18.7 acres of arable accreted land at tract T2016, resulting in a net loss of 408.4 acres of arable Tribal land (427.1 - 18.7 acres).

- The potential economic value of the lost Tribal land was estimated based on returns from dryland alfalfa crop production invested at 7 percent average annual yield for the period since the principal erosion occurred (either 1953 or 1976, as discussed in the text).
- The dryland alfalfa crop returns were estimated to be \$122.37 per acre, assuming above-average farm management practices and no land charges or management fees.
- The present day value of the lost Tribal land is estimated to be approximately \$1,000 per acre.
- Given these figures, the estimated present day value of the net Tribal lands lost to erosion during the period from 1953, at the completion of the Fort Randall Dam, to 1998 is approximately \$11,300,000.
- This evaluation does not take into consideration the future value of the eroded Tribal lands.

1.0 INTRODUCTION

The Yankton Sioux Tribe has been farming the fertile 'bottom lands' along the Missouri River for a number of generations. Since the diversion of the Missouri River for the construction of the Fort Randall Dam in the mid-late 1940s and through to the present, the Tribe has witnessed the rapid erosion of this prime farmland and the important source of Tribal revenue that it produced. The Tribe, in its pursuit of self determination, needs to retain and expand its farmland, not only for the revenues that are produced, but, equally as important, for the Tribal jobs that are created by farming. For these reasons, the Tribe considers the river bank erosion along the left bank of the Missouri River on Tribal land to be a primary concern of the Yankton Sioux Tribal Business and Claims Committee and has directed Pacific GeoScience to study the erosion of Tribal lands related to the construction and continued operation of Fort Randall Dam.

1.1 Background

The COE's report entitled, *Missouri River Review Report for Water Resources Development*, completed in the late-1970s, shows that during the 1946-1952 Fort Randall Dam construction period, 945 acres were lost on the 36.3 mile reach of the Missouri River between Fort Randall Dam and Niobrara, Nebraska. During the following period, 1953-1975, an additional 1,058 acres were lost to erosion. This reach of river includes most of the western boundary of the Yankton Sioux Reservation.

In October 1981, the COE, at the request of the Tribe, provided a Section 55, Streambank Erosion Protection Technical Assistance Report. The report identified five stream bank erosion problems between river miles 875 and 861 on the bank of the Missouri River in Charles Mix County, South Dakota. The report stated that during the period 1953-1976 the entire reach that contains our study areas has, "... experienced severe erosion; and it is not likely to cease in the foreseeable future." The report provides erosion estimates based on a comparison of 1974 and 1980 aerial photographs as well as general concepts for design alternatives, permits, and recommendations for stabilizing the riverbanks at the problem sites. It indicates that a detailed hydrographic survey is necessary to determine which of the erosion control structures would be best suited to the existing channel depths and conditions at each site. Implementation of the

detailed hydrographic survey or construction of control structures has not occurred to date.

In the early-1980s, the high rate of erosion caused by the release of sediment free water from the Fort Randall Dam spillway prompted the U.S. Fish and Wildlife Service to request that the COE protect a wildlife habitat through a riprap project along the right bank of the Missouri River, across the river from Tribal farmlands. Construction of this project occurred in 1984.

In the mid-1980s the Tribe brought the erosion of Tribal farmlands to the attention of local, state and federal agencies. Documentation of this effort is found in Tribal and other correspondence provided in Appendix A. Selected correspondence are as follows:

Letter to: The Honorable James Abdnor, United States Senator, May 24, 1985, from Alvin R. Zephier Yankton Sioux Tribal Chairman.

Letter to: The Honorable James Abdnor, United States Senator, September 27, 1985, from Alvin R. Zephier Yankton Sioux Tribal Chairman.

Letter to: Mr. Lowell Thomas, Project Manager, Fort Randall Dam, July 11, 1985, discussing problems with how the Section 55 study reported erosion, from Ed Hoylman, Kaman Tempo.

In 1985, the BIA provided funding for the development and installation of irrigation equipment for 390 acres of Tribal lands along the Missouri River. Several types of irrigation systems were installed and have been in operation since that time. Some of the irrigated fields are experiencing severe erosion that has limited the effectiveness of the irrigation equipment. Erosion is particularly significant on Tribal tract T2006 where the irrigation equipment will have to be modified, or irrigation terminated, if the stream bank is not stabilized to prevent future erosion.

1.2 Purpose of Study

The purpose of this study was to determine the amount of erosion/accretion that has occurred on Tribal lands along the left bank of the Missouri River during and following construction of the Fort Randall Dam, and to derive a value for the net eroded land. This study has focused on specific tracts of Tribal land and, in this respect, differs from earlier studies conducted by the COE. The COE's studies have evaluated general degradation and aggradation, along with sediment trends, for Tribal and non-Tribal lands along a 36-mile reach of the Missouri River below the Fort Randall Dam.

2.0 EVALUATION OF TRIBAL LAND EROSION

2.1 Aerial Photographic Analysis

On June 13, 1998, Horizons, Inc., of Rapid City, South Dakota, performed an aerial photographic survey (stereographic coverage) of the Missouri River from Fort Randall Dam to the Choteau River, a reach of the Missouri River that defines the west side of the Yankton Sioux Reservation. Selected photographs, covering the Tribal lands bordering the river, were enlarged to a scale of approximately 1:20,400 or 1:24,000 for use in this investigation. The boundaries of Tribal properties were defined on each aerial photo, along with the 1941, 1953, and current (1998) shorelines. The property boundaries and 1941 and 1953 shorelines were obtained from Figures 1 through 7 of the September 2, 1992, ENVIRON report. [Based on their report, ENVIRON obtained this information from a 1969 map of the Yankton Sioux Reservation prepared by the Department of Interior, Bureau of Indian Affairs, Aberdeen Office, Branch of Real Property Management.]

The 1941-1998 erosion area (that is, the area between the 1941 and 1998 shorelines) was digitized, then evaluated using AutoCAD LT[®] computer software. The erosion areas were calculated in square feet using the scale of the aerial photograph, then converted into acres. The scale of each aerial photograph was obtained using U.S. Geological Survey topographic maps of the same area. Road intersections and structures that could be identified in the 1998 photographs and on the topographic maps were used as reference points to calculate the scale of the photographs.

2.2 Eroded Tribal Land Acreage

The erosion study evaluated 17 tracts of Tribal land. With the exception of the T503, 507, and T2077 tracts (pasture lands), these tracts are prime arable land capable of supporting dryland or irrigated farming operations. Tract designations are given in Table 1 below, along with the amount of erosion/accretion that has occurred during the 1941 to 1998 study period. The location of each tract is shown in Figure 1, Missouri River Erosion, 1941-1998. The location of Fort Randall Dam in relation to the Tribal tracts is shown in Figures 1 and 2. The 1941 aerial photographs did not cover the T503, 507, and T2077 tracts, therefore, the 1941 shoreline could

not be shown. Figures 3 through 6 show the location of the 1941, 1953, and 1998 shorelines for each of the remaining Tribal tracts of land. The 1953 and 1998 shorelines are coincident at tract 716 (Figure 4). The 1953 shoreline has not been plotted in Figure 7 because 1953 aerial photographs were not available for this area. The June 13, 1998 aerial photographs are used as base maps for Figures 2 through 7.

Table 1. Erosion and Accretion of Tribal Lands Along the Missouri River During the Period 1941-1998

Tract Name	1941-1953 Erosion (acres)	1953-1998 Erosion (acres)	1941-1998 Erosion (acres)	1941-1998 Accretion (acres)
T503	No Data	0.5	0.5	
507	No Data	7.5	7.5	
T2077	No Data	15.2	15.2	
T2006	211.0	77.0	288.0	
193	5.8	3.8	9.6	
865-A	12.3	4.1	16.4	
510	11.0	0.5	11.5	
21	0.0	0.0	0.0	
716	5.9	0.0	5.9	
T2016	0.0	0.0	0.0	18.7
56-A	0.0	4.6	4.6	
T2024	15.2	3.8	19.0	
T2069	2.5	2.0	4.5	
63-A	12.6	4.2	16.8	
T219	13.0	1.5	14.5	
588, 33, 669	No Data	21.0	21.0	
493-A	No Data	15.3	15.3	
Total	289.3	161.0	450.3	18.7

The total estimated erosion of Tribal lands that occurred over the study period is 450.3 acres. Approximately, 64 percent of this erosion occurred during the period 1941-1953 with the remaining 36 percent occurring during the period 1953-1998. During the 1941-1953 period, 73

percent of all the erosion that occurred on Tribal lands took place at tract T2006. The amount of erosion of Tribal lands during the 1941-1953 period is unknown for tracts that did not have 1941 aerial photographic coverage, however, it is probably in excess of the acreage shown during the 1953-1998 period.

The most significant single erosion location is Tract T2006, shown in Figure 3. This tract extends from the north end of the figure to tract 193 to the south. Approximately 288.0 acres have been eroded from this location during the study period. This represents 64 percent of all the erosion that has been documented throughout the entire study period. Continued erosion at tract T2006 is directly affecting the operation of the linear sprinkler irrigation system installed at this location. The river intake pumping station that supplies water to the center pivot sprinkler (that irrigates the southern portion of T2006) has also been affected by the continuing erosion. The pump pad has undergone reconstruction nearly every year since its installation in 1985.

The only tract that has experienced accretion is T2016. Here, approximately 18.7 acres have been added to the tract. This tract of land is shown in Figure 5. The process of accretion occurring prior to the study period at tracts 588, 33, 669, and 493-A has been reversed, so that net erosion occurred for both tracts during the study period. These tracts are shown in Figure 7.

The 1946 photographs, used by the COE in their analysis, were not available to evaluate the erosion that occurred between 1941-1946 and 1946-1953. Therefore, pre-dam erosion characteristics could not be determined. However, Table C-7, Missouri River Bank Erosion Losses Fort Randall Dam to Niobrara, Nebraska, from Appendix 1 "Missouri River Review Report for Water Resources Development," indicates that total erosion losses for the period 1946-1953 was 945 acres (see Appendix A of this report). The COE study area extended from the mouth of Niobrara River to Fort Randall Dam, 1960 river miles 843.7 to 880, for a total distance of 36.3 river miles. Sixteen shoreline miles of the reach are in contact with high bluffs (4.5 miles on the left bank, Yankton Sioux Reservation, and 11.9 miles along the right bank, Nebraska side of the river). Erosion of the resistant sediments that form the high bluffs is generally less than the 'bottom lands' that predominate on the left bank. Although the COE study reach was longer than the length of river evaluated during this study, the COE erosion estimates show that a majority of erosion occurred after dam construction had commenced in 1946. This is consistent with our opinion that the majority of the erosion that occurred during the 1941-1953 period took place during the later 6 years of this period and is related to river diversion as a result of dam construction.

3.0 ESTIMATED VALUE OF ERODED TRIBAL LANDS

The estimated value of the net eroded Tribal lands can be determined by evaluating the following factors:

- Potential use of the eroded land,
- Economic return that could have been realized from the land,
- Investment of the economic returns from land use over the 45-year study period, and
- Present day value of the land.

These factors are discussed in the following sections.

3.1 Potential Use of Eroded Land

All of the 450.3 acres of eroded Tribal land were located along the Missouri River and nearly all of this property was prime arable land. This 'bottom land' acreage was flat to gently sloping, adjacent to a source of irrigation water. The 'bottom lands' along the river are primarily in dryland and irrigated alfalfa hay production, with some corn production. The U. S. Soil Conservation Service generally classifies these lands as having Albaton or Aowa soil types that produce high crop yields.

A portion of the lost acreage, approximately 5 percent, is not considered arable land based on topography and access for farming equipment. Tribal tracts T503, 507, T2077 (23.2 acres of eroded land) have a potential return as pasture land and, except for their present day value, are not included in the determination of the value of the eroded land discussed below.

3.2 Potential Return From Eroded Land

The potential economic return that could have been realized if the eroded lands were cultivated in alfalfa hay can be estimated by evaluating the receipts from alfalfa cultivation less the cost of farming. Farming costs include direct operating and fixed costs. The costs and the return for dryland alfalfa production are summarized in Table 2. This table includes unit prices and selected cost elements provided by Dr. Donald Peterson, Marketing/Management Economist of the Cooperative Extension Service, South Dakota State University, U. S. Department of

for estimating farming costs in Charles Mix County.

Table 2. Dryland Alfalfa Budget

RECEIPTS	Dryland Alfalfa
Estimated grain yield (tons/ac.)	4.5
Estimated selling price or value (\$/ton)	\$65.00
I. Total Income, Per Acre	\$292.50
DIRECT COSTS	Dryland Alfalfa
Crop Establishment Cost (\$/ac.)	\$28.00
Fertilizer (\$/ac.)	\$13.00
Fertilizer application (\$/ac.)	\$3.00
Insecticide (\$/ac.)	\$0.00
Insecticide application (\$/ac.)	\$0.00
Baling costs (\$/ac) custom	\$30.00
Storage (\$/ton)	\$4.00
Storage (\$/ac.)	\$18.00
Overhead (\$/ac.)	\$3.50
Irrigation, fuel and repair (\$/ac.)	\$0.00
Fuel and lubrication (\$/ac.)	\$4.80
Machinery repair (\$/ac.)	\$10.00
Crop operating loan borrowed (month)	9
Interest APR	8%
Crop direct costs borrowed	60%
Interest on direct costs (\$/ac.)	\$3.97
II. Total Direct Operating Costs, Per Acre	\$114.27
Income over direct costs (I minus II)	\$178.23
Break-even price per unit (direct costs)	\$25.39
FIXED COSTS	Dryland Alfalfa
Average machinery investment (total \$/yr)	\$7,500.00
Total acres machinery investment used (ac.)	70
Interest on machine investment @10% (\$/ac.)	\$10.71
Depreciation on machinery and equipment over 7.5 yrs. (\$/ac.)	\$14.29
Machinery housing and insurance @1.5% (\$/ac.)	\$1.61
Operator labor (hrs./ac.)	3.9
Operator labor cost (\$/hr.)	\$7.50
Operator labor cost (\$/ac.)	\$29.25

Real estate taxes (\$/ac.)	\$0.00
Land charges (\$/ac.)	\$0.00
Management fees	\$0.00
III. Total Fixed Costs, Per Acre	\$55.86
SUMMARY OF PRODUCTION COSTS AND YIELDS	Dryland Alfalfa
Production cost (\$/ton)	\$37.81
Production cost (\$/ac., excluding land/management)	\$170.13
Total cost (\$/ac.)	\$170.13
Break-even price (\$/ton) to recover total cost	\$37.81
Break-even yield (tons/ac.) at selling price	2.6
Income Over All Costs, Per Acre	\$122.37

The alfalfa budget input parameters (i.e., production, selling price, direct and fixed costs) are based on the assumption of above-average farm management and crop production on prime, arable 'bottom land' along the Missouri River. Alfalfa dryland production of 4.5 tons per year is based on alfalfa budgets for 1996 prepared by the Cooperative Extension Service (CES) at South Dakota State University. The CES alfalfa production of 2.00 tons for the seeding year (Budget SE-424-1) and 5.00 tons of premium alfalfa per acre (Budget SE-425-1) thereafter is an average return for land located in Southeast South Dakota (including Bon Homme, Clay, Hutchinson, Turner, Charles Mix, Douglas, Lincoln, Union, and Yankton Counties). This would result in a long term average production rate of 4.4 tons per year. The prime Tribal 'bottom lands' along the Missouri River (in Charles Mix County) lost to erosion are expected to produce more alfalfa per acre than the average return for land located in Southeast South Dakota. The 1998 price of good quality small square bales of alfalfa is estimated by CES at \$75.00 per ton. Premium quality small bales of alfalfa are valued by CES at \$95.00 per ton. A price of \$65.00 per ton was used in conjunction with other 1998 costs to determine the dryland alfalfa return of \$122.37 per acre. The dryland return does not include land charges or management fees (i.e., it assumed that the Tribe owns the land and manages crop production). The lower crop price (i.e., \$65.00 instead of \$75.00 or \$95.00 per ton) has been used to determine the estimate of income over all costs for the alfalfa production because this is considered to be more representative of the average returns that could be expected over the 45-year study period. Although crop returns have varied over the 45-year study period, it is generally believed that production costs have increased more rapidly in recent years relative to the crop selling price, yielding lower per acre net returns, and that the above-estimated return is meaningful in determining the return to land and management for the study period.

The present day value of the eroded Tribal land can be estimated based on the number of acres lost, the date of loss, the potential per acre return from that land, and its current market value. This analysis does not take into consideration the future value of the land to the Tribe.

Table 1 shows that the total number of acres lost to erosion is equal to 450.3 acres.

Approximately 95 percent of this land is considered arable (450.3 acres less the 23.2 acres from tracts T503, 507, and T2077, or 427.1 acres). Inspection of the 1953 shoreline in the aerial photographs (Figures 2-7) shows that by 1953 a minimum of 68 percent of the arable land (289.3 acres) had been eroded. [No 1953 shoreline data exists for tracts 588, 33, 669, and 493-A in Figure 7; 36.3 acres of erosion occurred in these tracts from 1941 to 1998, a large portion of which probably eroded prior to 1953.] Therefore, potential annual dryland alfalfa returns were lost for 289.3 acres over a 45-year period. The remaining 32 percent (137.8 acres) eroded during the period between 1953 and 1998. It is reasonable to assume that the majority of the erosion occurring from 1953 to 1998 happened in the first 23 years of the 45-year study period (1953 to 1976). Although the time that 18.7 acres of land was accreted to tract T2016 is not known (based on the aerial photographs used in the ENVIRON report it had occurred prior to 1988), we have assumed it occurred prior to 1976. Consequently, potential annual dryland alfalfa returns for 119.1 acres (137.8 acres minus 18.7 acres) were lost for a 22-year period (from 1976 to 1998).

If the annual dryland alfalfa returns were invested and achieved a 7 percent annual rate of return over the 45 and 22-year periods, the present day value of these returns and investments would be \$10,155,835 and \$714,232, respectively. The 7 percent rate of return is considered a conservative number for the determination of the value of the eroded Tribal land, especially for the later part of the study period. (Note that the Vanguard Index 500 Fund, established in August 1976, has an average return of 15.08 percent through October 1998.) The present market value of the eroded land is approximately \$1,000 per acre. Given these numbers, the estimated value of the eroded Tribal land is \$11,301,667, as indicated in Table 3 below.

Table 3. Estimated Value of Eroded Tribal Land

Yankton Sioux Tribal Land (total lost acreage):	450.3 acres
95% of lost acreage was arable land (427.1 acres), less 18.7 acres of arable accreted land:	408.4 acres
Value of arable land (289.3 acres of dryland alfalfa returns @ 7% interest for 45 years):	\$10,155,835
Value of arable land (119.1 acres of dryland alfalfa returns @ 7% interest for 22 years):	\$714,232
Estimated present day value of eroded land @\$1,000/ac. (450.3 acres less 18.7 acres):	\$431,600
ESTIMATED VALUE OF ERODED TRIBAL LANDS:	\$11,301,667

4.0 RECOMMENDATIONS

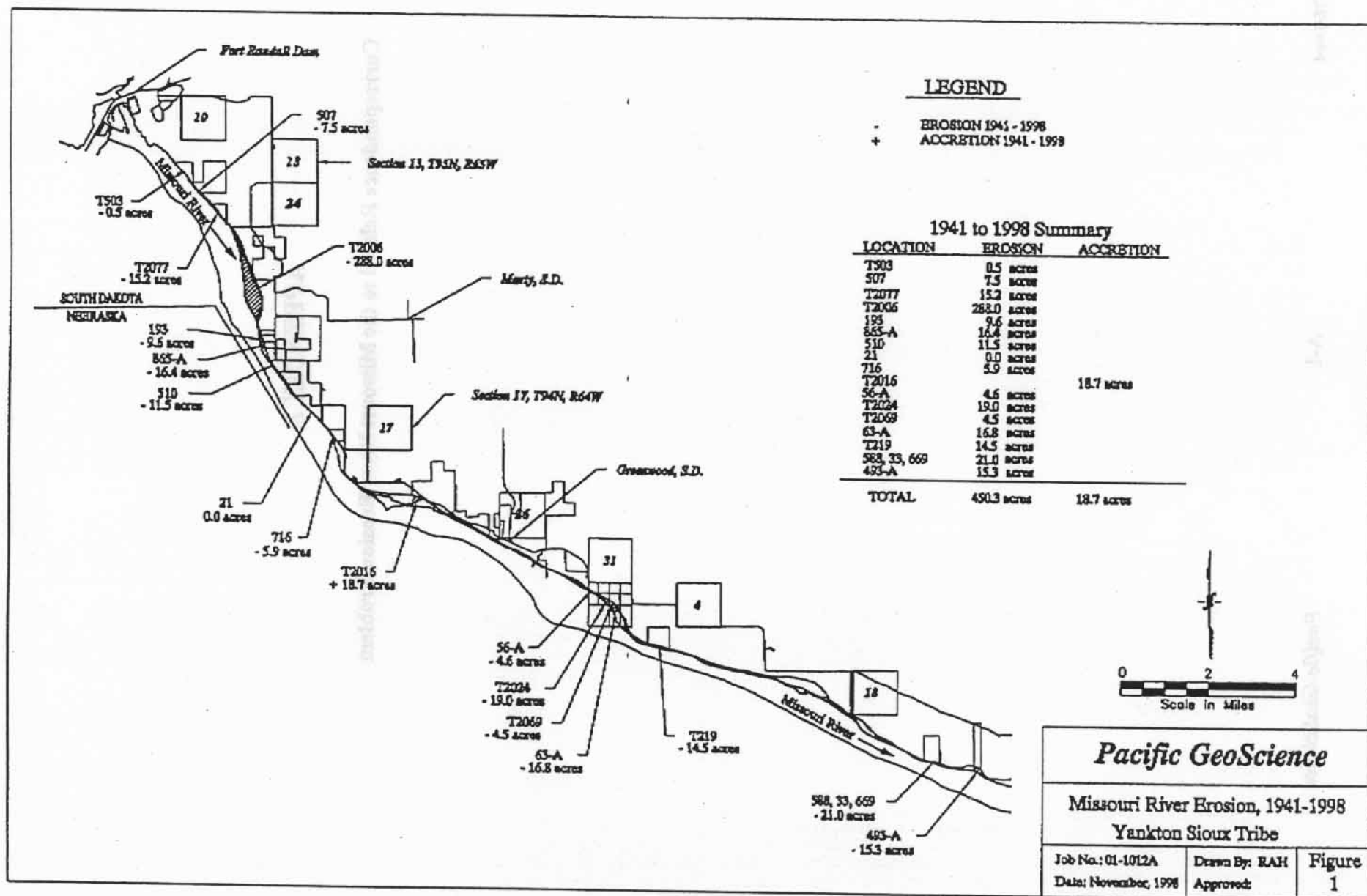
Missouri River bank erosion has been severe along the Yankton Sioux Reservation following the installation of Fort Randall Dam. The following recommendations are given to help correct the erosion problems and begin the negotiations needed to come to an equitable settlement regarding the Tribal lands lost to erosion.

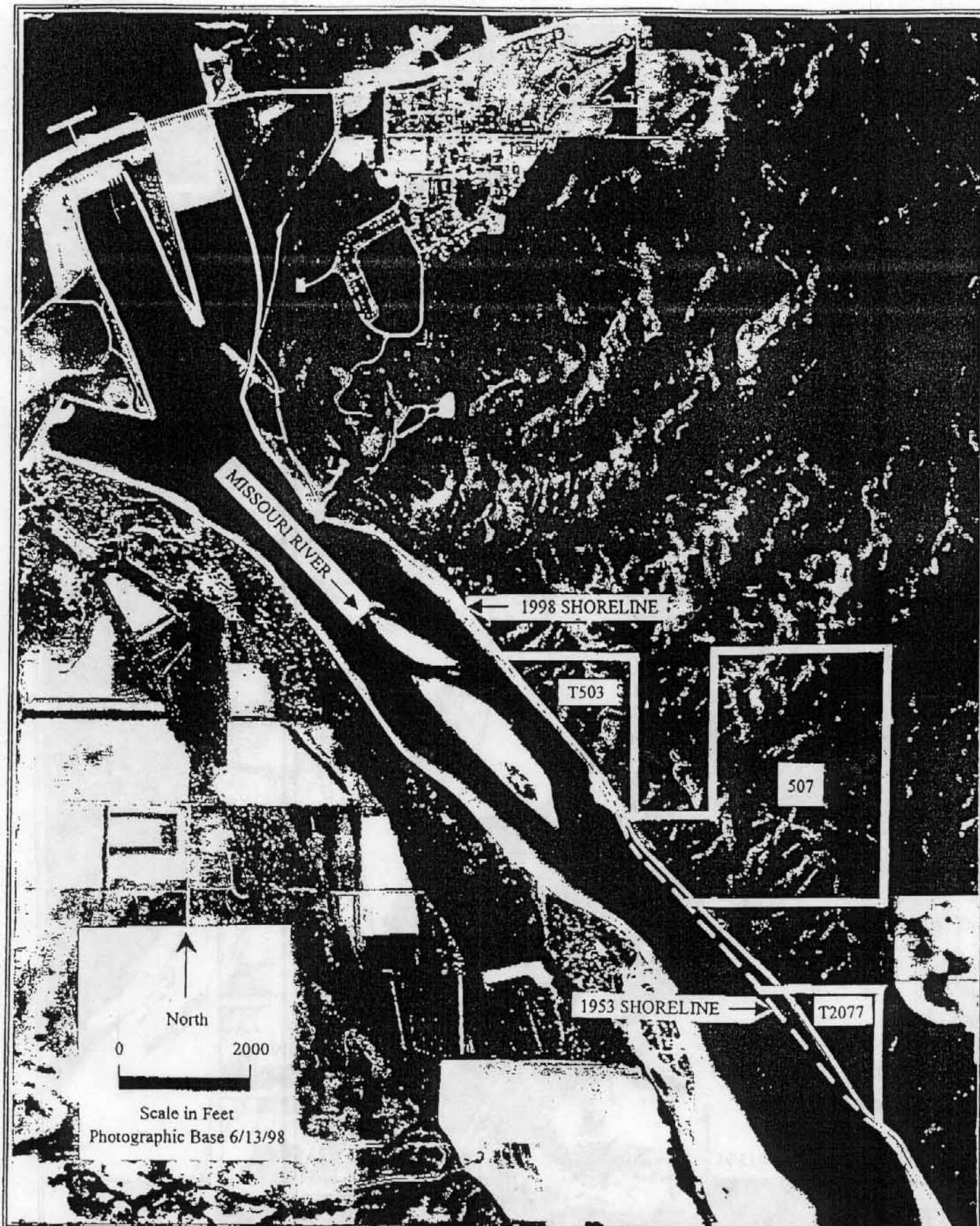
- Develop a short-term remedial program, in addition to that already implemented by the Tribe, to stop the erosion along tract T2006 that threatens the linear irrigation system installed on that property (Figure 3).
- Initiate discussions with State Senators and Congressmen (presentation of study findings) to ensure they are aware of the severity of the problem and solicit assistance for both short and long term solutions.
- Pursue monetary compensation options, through Section 33 of the Water Resources Development Act of 1988 and other funding sources, to alleviate bank erosion and related problems associated with reservoir releases along the Missouri River.
- Present erosion study findings to appropriate agencies in Washington, D.C. to secure support for a final settlement for lost Tribal lands.



APPENDIX A

Correspondence Related to the Missouri River Erosion Problem



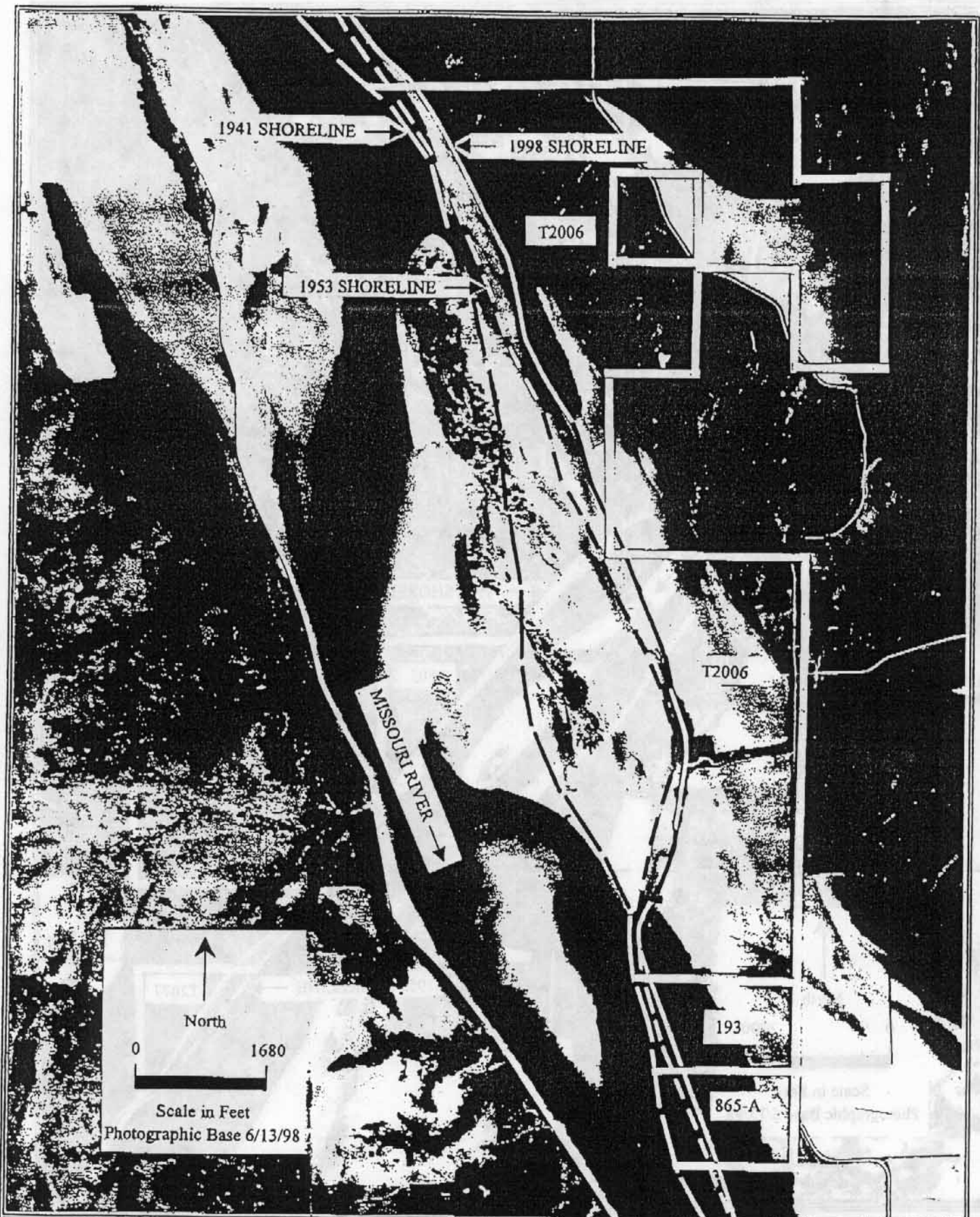


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Missouri River
Erosion Update
Yankton Sioux Reservation

Figure
2

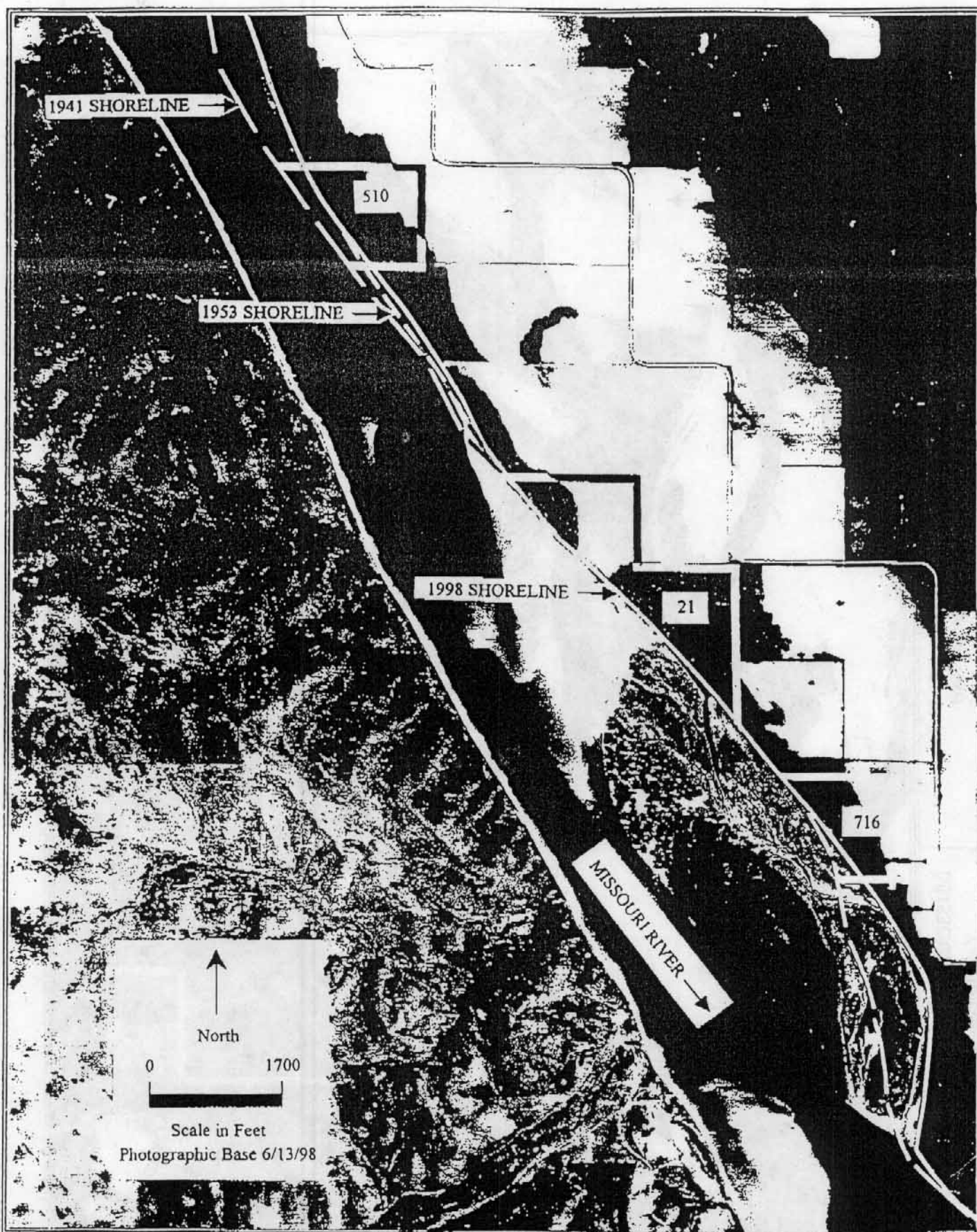



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Missouri River
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Yankton Sioux Reservation

Figure
3

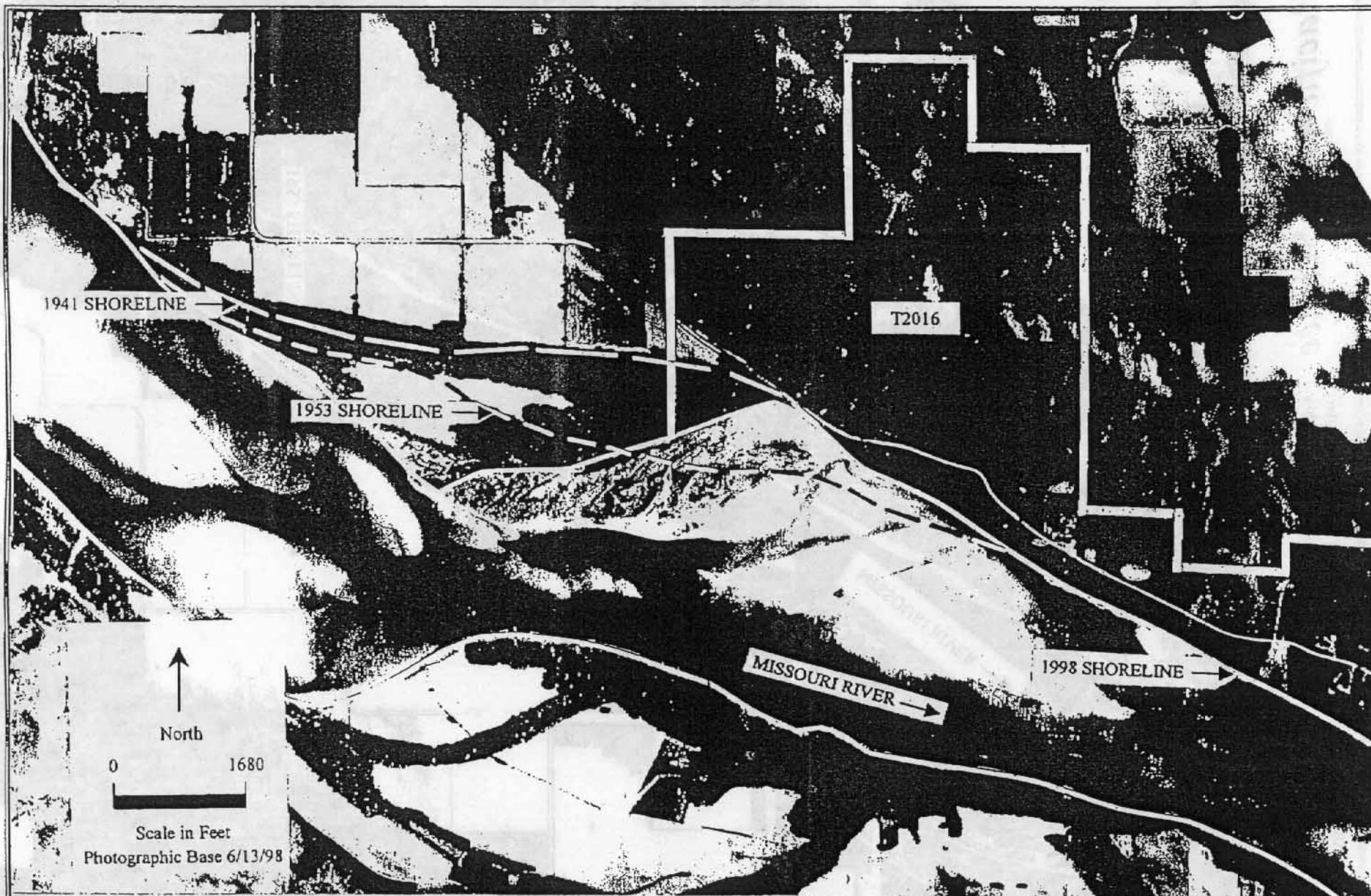


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Missouri River
Erosion Update
Yankton Sioux Reservation

Figure
4

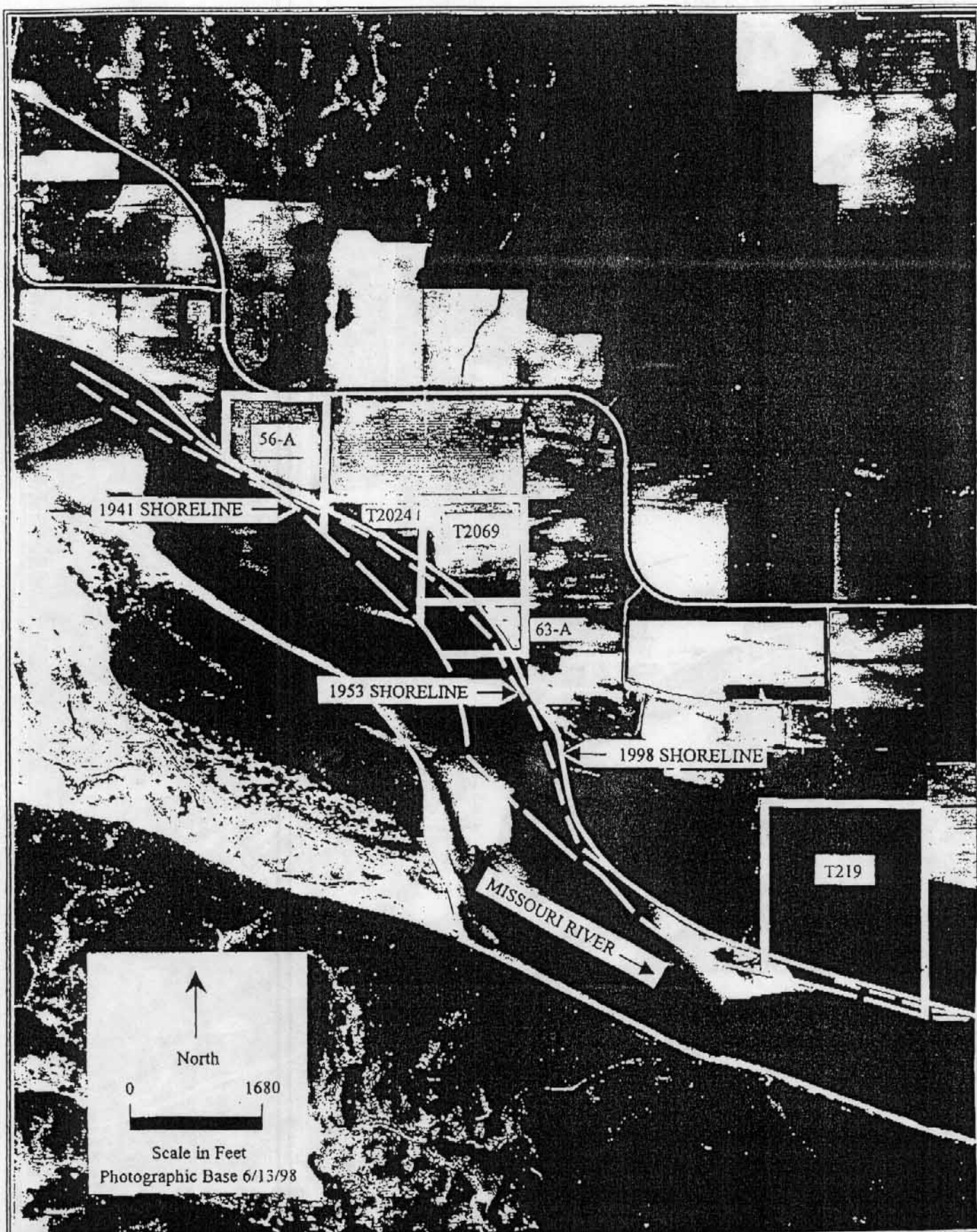


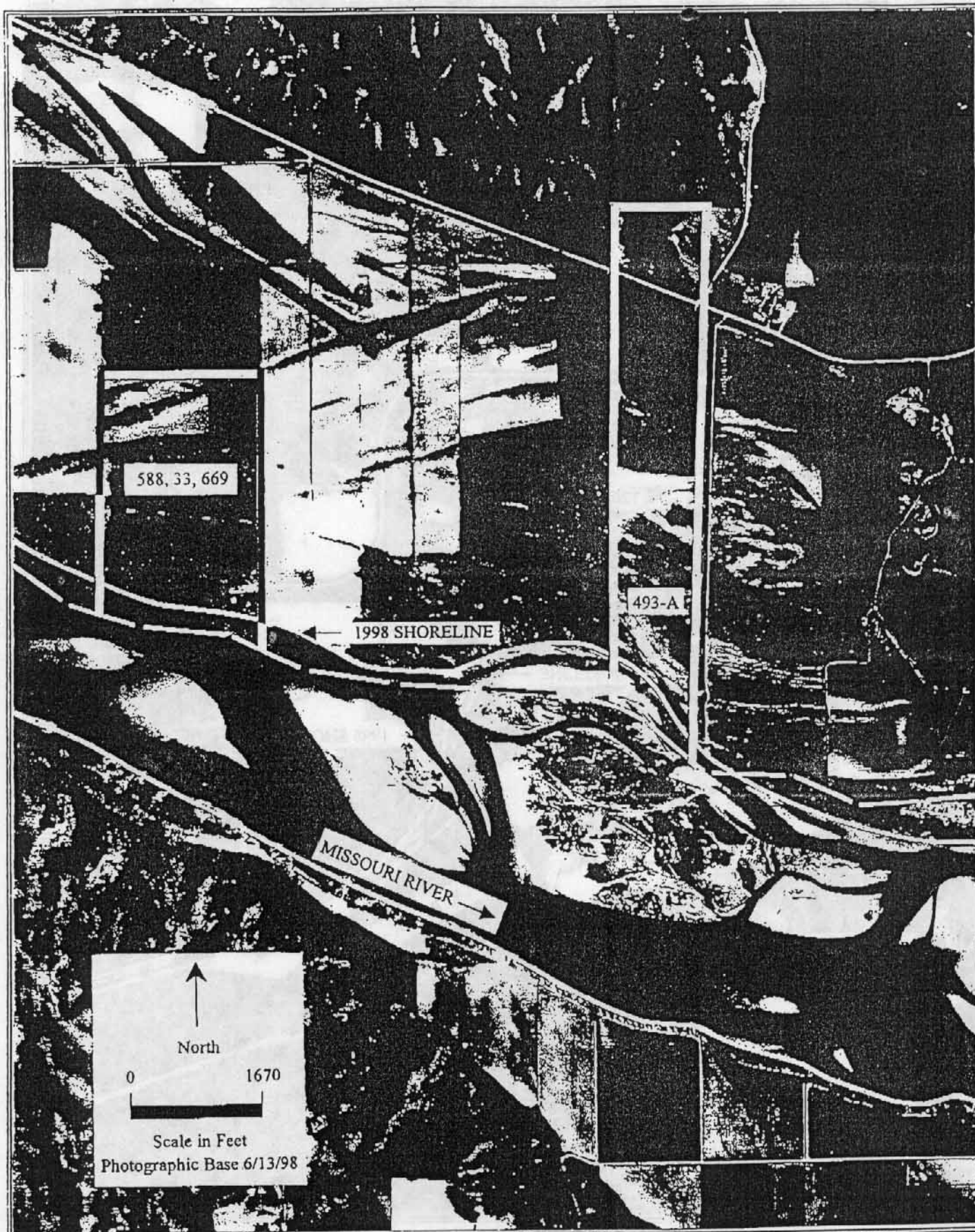
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Missouri River Erosion Update
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Figure
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Missouri River
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Figure
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